

CERES Meeting Objectives

1. Review status of CERES Instruments and Data Products:

- Status of CERES/NASA/EOS/CERES on NPP and Beyond
- NPP Mission Overview and the new Joint Polar Satellite System (JPSS)
- Terra and Aqua SW/LW/TOTAL channel calibration for Edition 3; CERES FM5, FM6 Update
- Edition 3 cloud algorithm development and validation
- CRS Edition 3 Algorithm Development Progress/Edition2 CRS & SYN Validation
- **Towards Early Release of 10-years of Climate-Quality L3 Daily and Monthly CERES TOA Fluxes—CERES “Lite” Products**
- Update on SYN/AVG/ZAVG: the L3 Gridded Version of Computed TOA/ATM/SFC fluxes
- ISCCP-like MODIS & GEO Data Products
- **New Prototype CERES Subsetting/Visualization/Ordering Tool for L3 Data Products**
- GEWEX Radiative Flux Assessment Update
- Data Management Team Update: Terra/Aqua/NPP
- Atmospheric Sciences Data Center (ASDC) Update
- CERES Education Outreach

2. Science Reports.

3. Poster: NICSE Post-Launch Radiometric Calibration Support for VIIRS SDR Assessment - V. Chiang



State of CERES/NASA/EOS/CERES on NPP and Beyond/Decadal Survey Missions

Norman G. Loeb, NASA LaRC
CERES Science Team Meeting April 27, 2010, Newport News, VA

NASA Earth Science

- **NASA Administrator is Charles Bolden, Jr.**
- **AA for Space and Earth Science is Ed Weiler.**
- **Head of Earth Science is Mike Freilich.**
- **Jack Kaye is Associate Director for R&A.**
- **David Considine is NASA HQ Modeling lead and CERES Program Scientist.**
- **Hal Maring remains Radiation Sciences program lead.**
- **Steve Volz is the Earth Science Deputy for Missions.**
- **Richard Slonaker is Program Executive, NASA-HQ.**

NASA Science Mission Directorate FY11 President's Budget Request

	FY09	FY10	FY11	FY12	FY13	FY14	FY15
Science	\$4,903.1	\$4,493.3	\$5,005.6	\$5,248.6	\$5,509.6	\$5,709.8	\$5,814.0
Heliophysics *	\$607.8	\$627.4	\$641.9	\$647.6	\$679.8	\$704.4	\$750.8
Astrophysics	\$1,304.9	\$1,103.9	\$1,076.3	\$1,109.3	\$1,149.1	\$1,158.7	\$1,131.6
Planetary Science	\$1,288.1	\$1,341.3	\$1,485.7	\$1,547.2	\$1,591.2	\$1,630.1	\$1,649.4
Earth Science	\$1,702.3	\$1,420.7	\$1,801.7	\$1,944.5	\$2,089.5	\$2,216.6	\$2,282.2

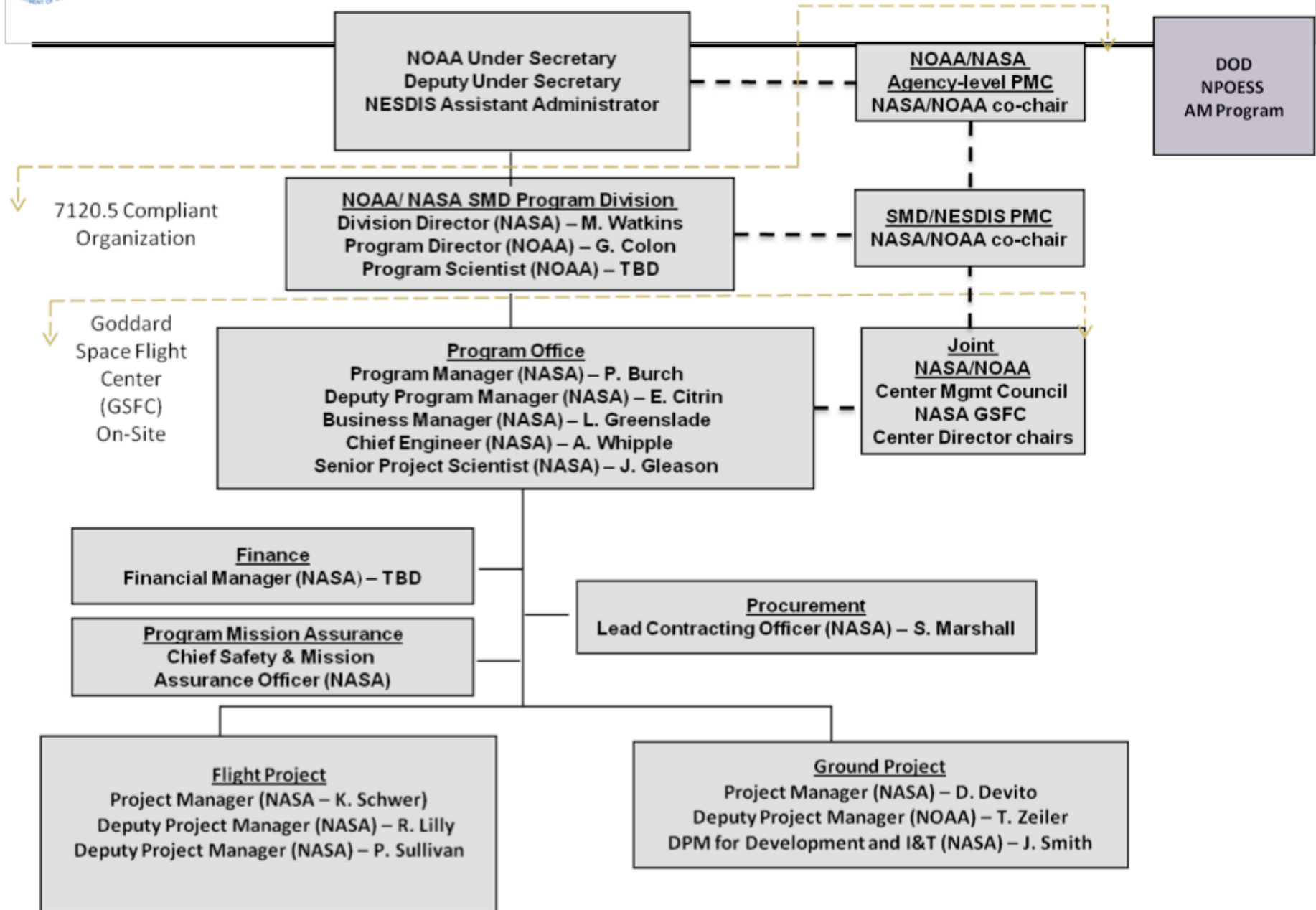
- Increases across the board from FY10 to FY15. Earth Science increases by 60%.
- FY11 ES increases by \$382 million over FY 2010 enacted, and \$1.8 billion over 4-years (FY 2011-14) compared to the FY 2010 Budget;
- Re-flies the Orbiting Carbon Observatory, which is critical to our understanding of the Earth's carbon cycle and its effect on climate change;
- Accelerates the development of new satellites to enhance observations of the climate and other Earth systems;
- Expands and accelerates Venture-class competitive PI-led missions;
- Enhances climate change modeling capabilities to enhance forecasts of regional and other effects;
- Operates 15 Earth-observing spacecraft in orbit and launches Glory, NPP, and Aquarius;
- Proceeds toward completion and launch of remaining foundational missions: LDCM (6/13) and GPM (7/13).

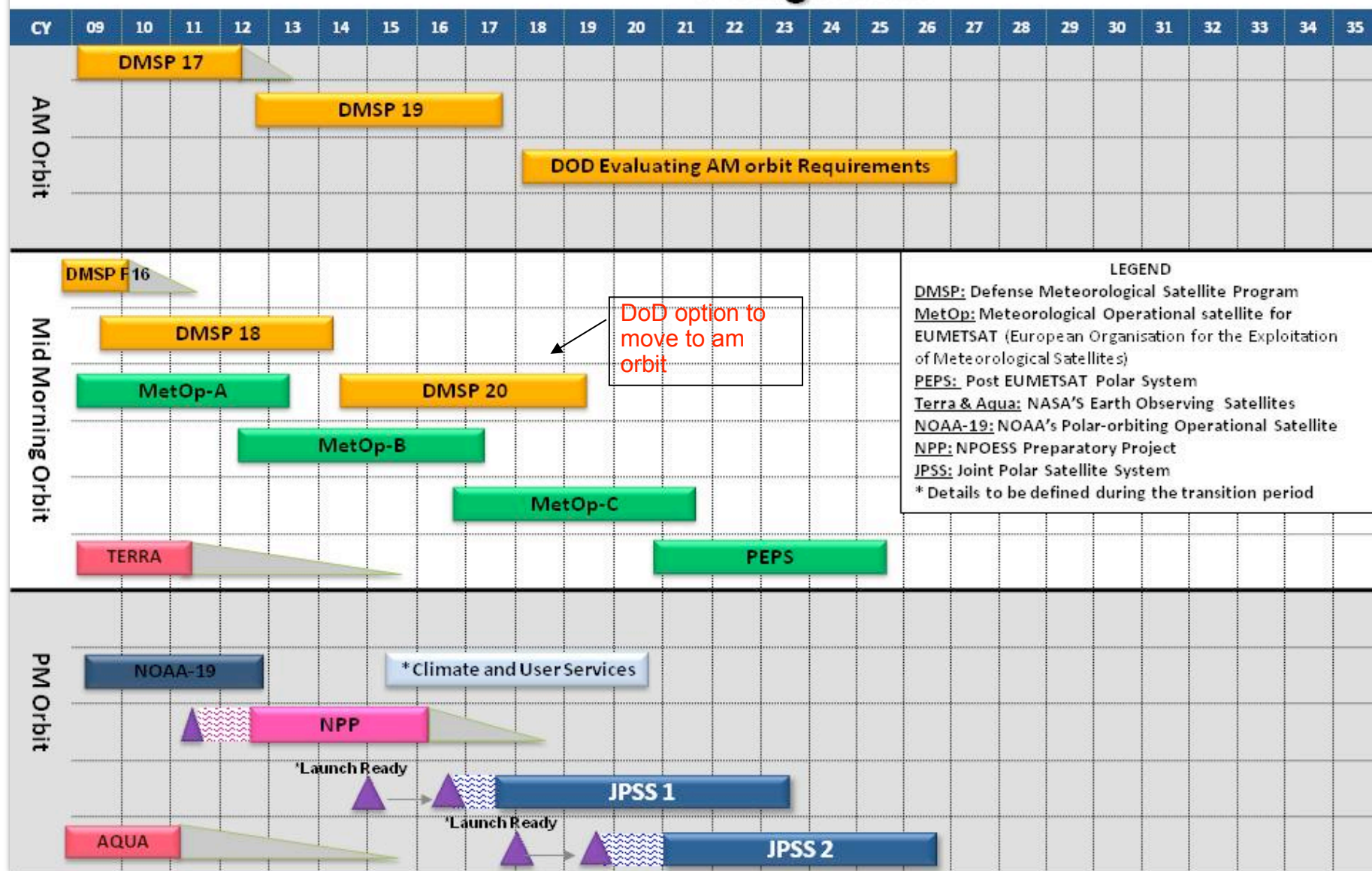
NPOESS Restructuring

- **NPOESS is a national priority – essential to meeting both civil and military weather-forecasting, storm-tracking, and climate-monitoring requirements**
- **An Administration task force and independent reviews have concluded that the current program cannot be successfully executed with the current management structure, and with the current budget structure.**
- **These challenges originate in large part because of a combination of management deficiencies that result from conflicting perspectives and priorities among the three agencies who manage the program.**
- **Absent a major restructuring, the Agencies would have continued to face major risks in executing the current program, threatening our ability to ensure weather and climate observations.**

Administration Decision on Restructuring

- Acquisition responsibilities will be shared:
 - NOAA/NASA responsible for the PM orbit – to be called Joint Polar Satellite System (JPSS).
 - DoD (AF/SMC) responsible for the early AM orbit.
 - Agencies will share a common ground system to be managed by NOAA/NASA.
 - Agencies will share data from each orbit to meet the national need for weather and climate information.
- Mid and early-AM orbits covered by EUMETSAT and remaining DOD/DMSP platforms.
- Acquire 2 lower risk JPSS satellites.
- Observations planned in the PM orbit for NPOESS are maintained.
 - VIIRS, CrIS, ATMS, OMPS, and CERES/ERBS remain
 - AMSR sensor data from Japanese GCOM satellite to replace MIS for microwave imaging/sounding.
- Continue plan for operational use of NPP data (PM orbit) with a Fall 2011 launch readiness date.





CERES Team Leads

- **Principal Investigator: Norman Loeb**
- **Project Scientist: Kory Priestley**

CERES Working Groups:

- **Instrument: Kory Priestley**
- **ERBELike: Takmeng Wong**
- **Clouds: Pat Minnis**
- **Inversion: Norman Loeb**
- **SOFA: David Kratz**
- **SARB: Tom Charlock**
- **TISA: David Doelling**
- **FLASHFlux: Paul Stackhouse & David Kratz**
- **Data Management: Jonathan Gleason**
- **ASDC: John Kusterer**

CERES Terra/Aqua News (cont'd)

- CERES featured on NPR's Earth and Sky
- CERES Received Pecora Award at Fall AGU
- Requests for CERES data to support IPCC AR5
- CERES mentioned in the University of East Anglia Climate Research Unit (CRU) email hacking incident.
- CERES featured in Space News article *"NASA Researchers Aim To Keep 'Infinite CERES' Instrument Going Strong"*.
- CERES Ocean Validation Experiment (COVE) Site:
 - Operates instruments from BSRN, AERONET, MPL
 - US Coast Guard wants to excess or auction off the Chesapeake Lighthouse platform.
 - It is not feasible for CERES (NASA) to take over platform (too expensive to maintain).
 - State and local (VA Beach) governments considering.
 - Lighthouse will be auctioned off this year if no government assumes responsibility for lighthouse.
 - Our goal is to continue observations regardless of who assumes responsibility for lighthouse.

Upcoming Conferences & Meetings of Interest

EGU:

- May 2–7, 2010. Vienna, Austria.

AMS Radiation Conference (Joint with Cloud Physics):

- June 28–July 2, 2010. Portland OR.
 - > \approx 40 papers that use CERES (21% of AtRad Conf).

CALCON:

- July 18–23, 2010. Colorado Springs, CO.

COSPAR:

- July 18-25, 2010. Bremen, Germany.

IGARRS:

- Terra at 10 session. July 26-30. Honolulu, HI

EUMETSAT Meteorological Satellite Conference:

- September 20-24, 2010. Cordoba, Spain.

CERES Science Team Meeting:

- Fall 2010: Sept 13-16. Paris, France. CERES/ScaRaB/GERB/LMD

A-Train Symposium:

- October 25-28, 2010. New Orleans, LA (abstracts due: Aug 15).

Fall AGU:

- December 13-17, 2010. San Francisco, CA

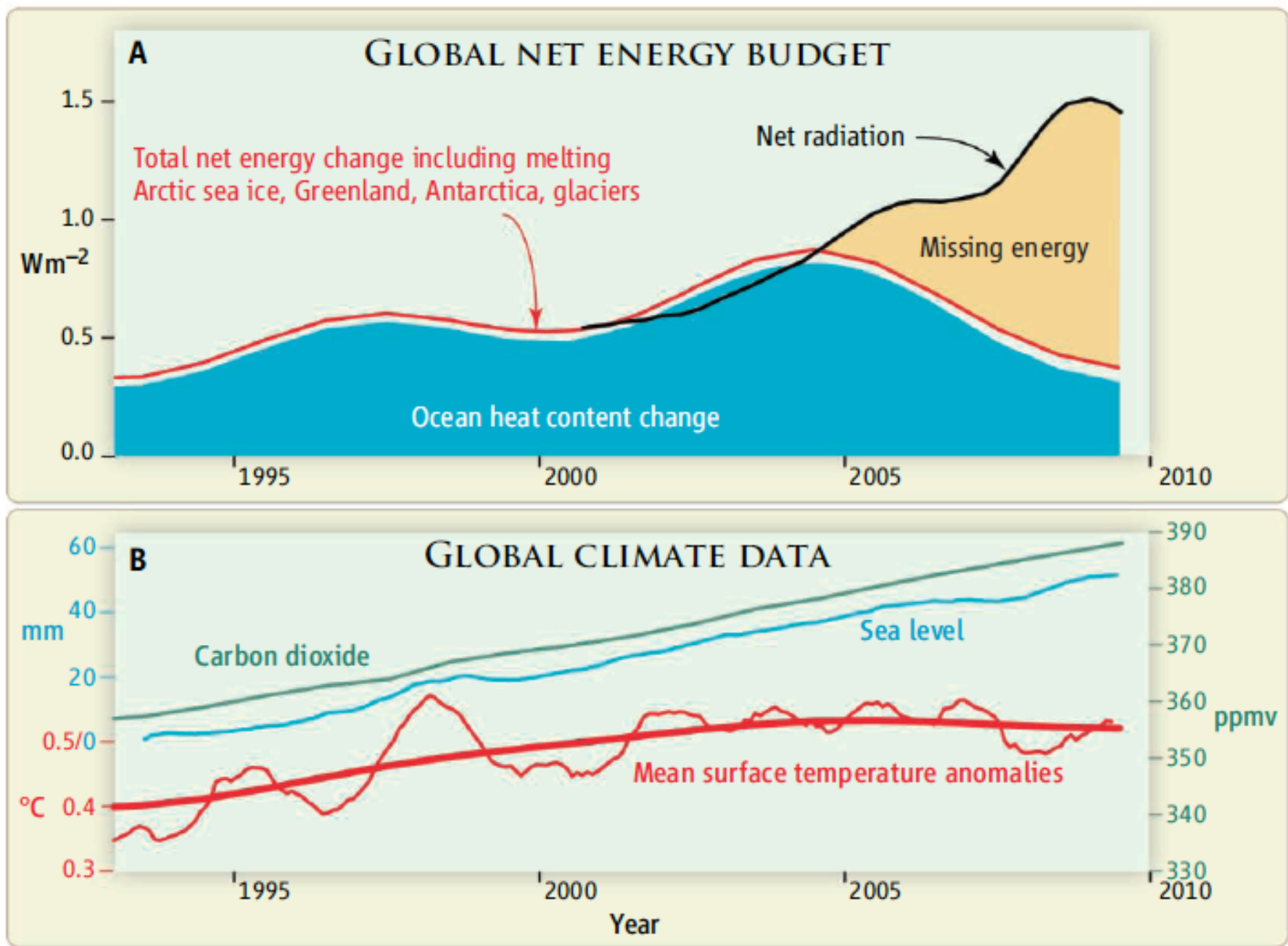
Terra/Aqua Update

Early Release of Edition3-Quality Level-3 Data Product

- Working on early release of Level-3 CERES Terra data products with Edition3 calibration improvements (especially calibration stability).
- New CERES data product is a hybrid of Edition2 and Edition3.
 - > Uses best-quality Edition3 instrument radiances and Ed2 cloud properties to generate L3 TOA fluxes as quickly as possible. Currently through end of 2008.
 - > Saves approximately 2 years of time before any of the official Edition-3 L3 CERES data products are released.
 - > Will consist of a small subset of SRBAVG cloud and TOA radiation parameters.
 - > Will be accompanied by a new prototype subsetter/ visualization/ordering tool available for testing.
- Details in Dave Doelling's presentation this afternoon.

Selected CERES Science Updates

- Two new CERES cloud papers submitted for publication to IEEE Trans. Geosci. Remote Sens. One is on cloud retrieval algorithms, the second is on results & validation.
- Trenberth paper in Science (Perspectives Article entitled “Tracking Earth’s Energy”).
 - Measuring net incoming and outgoing radiation at TOA indicates how much energy remains in the Earth system.
 - Most of this excess energy (~90%) is absorbed in the ocean; rest goes into melting sea and land ice and heating the land surface and atmosphere.
 - Satellite measurements (CERES) show an increase in net radiation associated with the 2008 La Nina.
 - Ocean temperature measurements (Argo floats) from 2004 to 2008 suggest a substantial slowing of the increase in global ocean heat content.
 - Gravity measurements from GRACE suggest an increase in ocean mass due to increasing glacial land ice melt since 2003.
 - Sea level observations from satellite altimeters suggest a linear global increase of ~3.2 mm per year and a brief slowdown in the 2007–2008 La Niña.



Trenberth and Fasullo, 2010 (Science)

Quotes of Note:

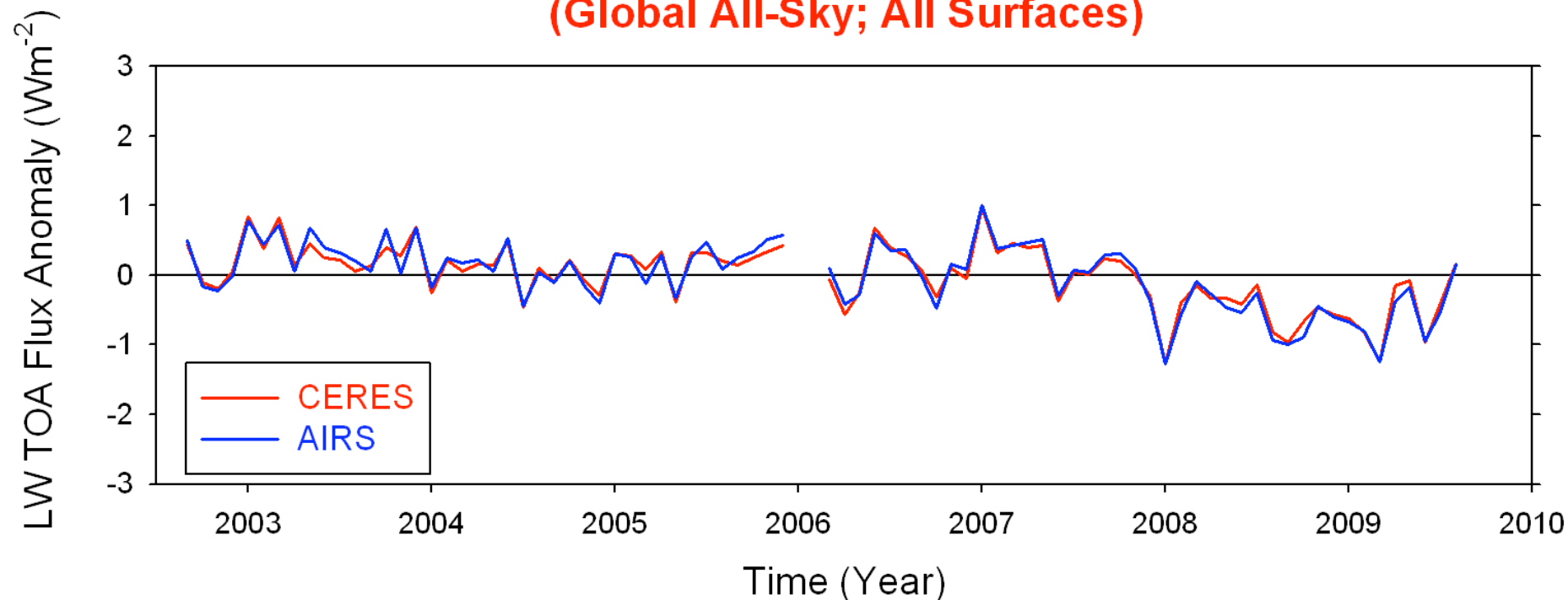
“The fact is that we can’t account for the lack of warming at the moment and it is a travesty that we can’t. The CERES data published in the August BAMS 09 supplement on 2008 shows there should be even more warming: but the data are surely wrong. Our observing system is inadequate.”

(Kevin Trenberth: Hacked email to Micheal Mann, Oct 2009)

“Existing observing systems can measure all the required quantities, but it nevertheless remains a challenge to obtain closure of the energy budget. This inability to properly track energy—due to either inadequate measurement accuracy or inadequate data processing—has implications for understanding and predicting future climate.”

(Trenberth and Fasullo, 2010)

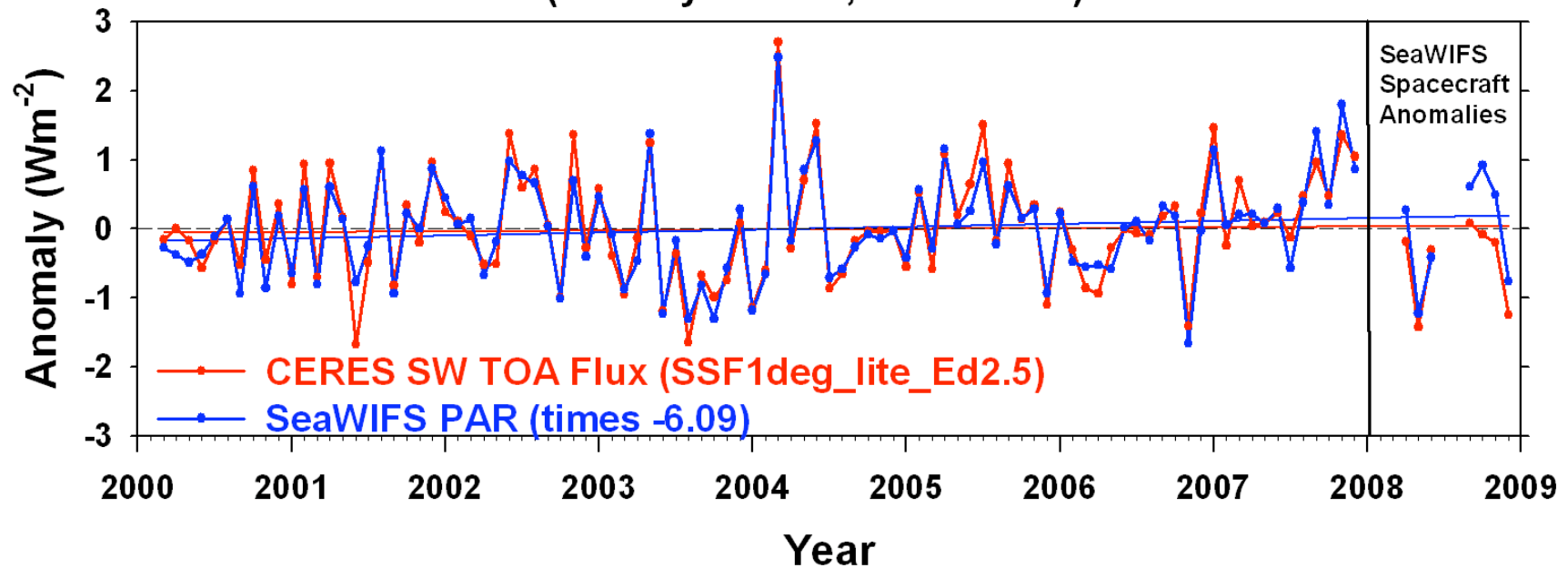
LW TOA Flux Anomalies: CERES FM1 Terra and AIRS Aqua (Global All-Sky; All Surfaces)



CERES Anom Minus AIRS Anom: $-0.097 \pm 0.13 \text{ Wm}^{-2}$

✦ ***Shows consistent calibration stability at $< 0.2 \text{ Wm}^2$ per decade (95% conf)***

CERES & SeaWiFS Comparison (All-Sky Ocean; 30°S-30°N)



CERES Anom Minus SeaWiFS Anom: $-0.106 \pm 0.2 \text{ Wm}^{-2}$ per decade

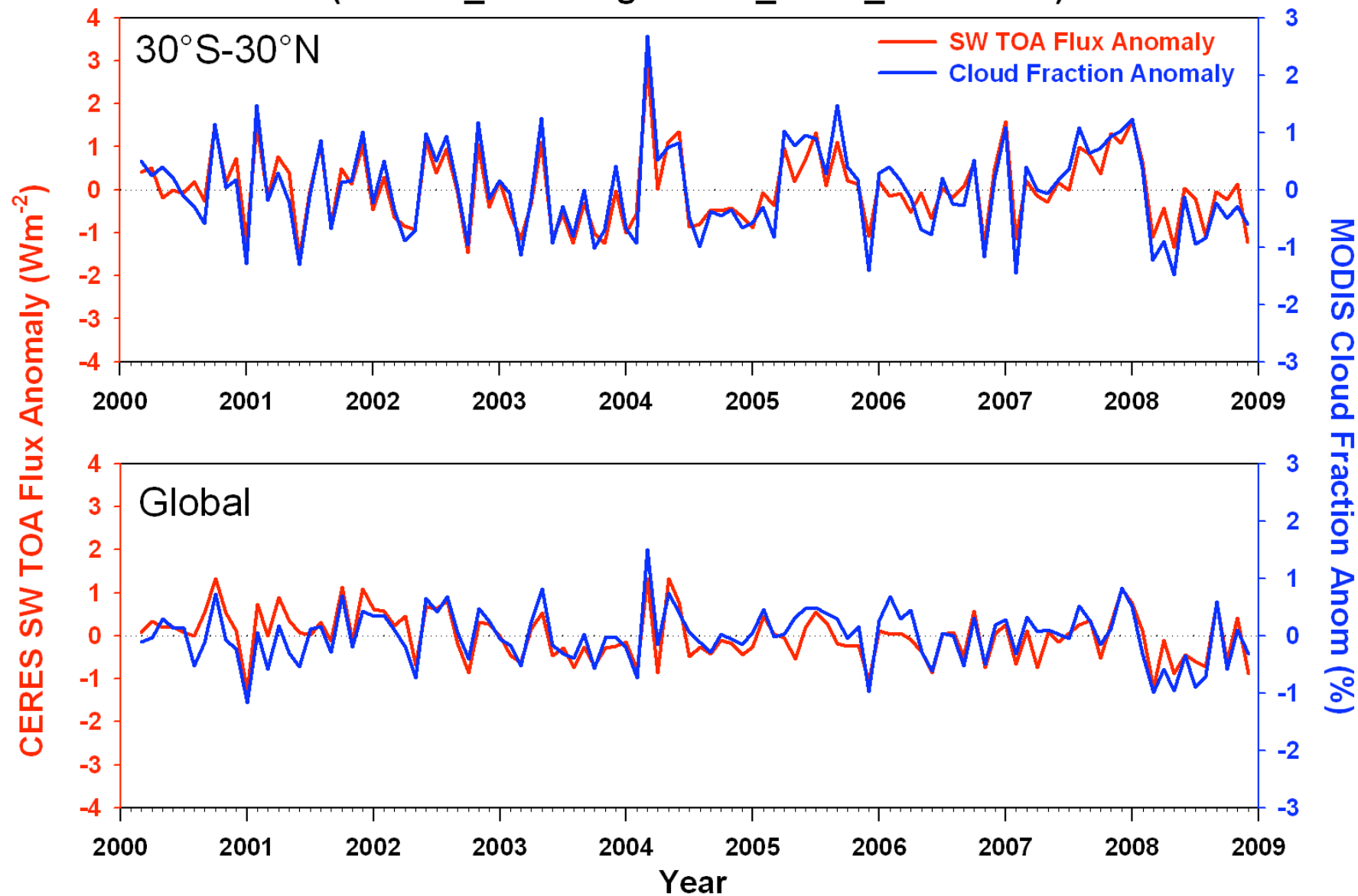
CERES Variability (1σ) = 0.79 Wm^{-2}

SeaWiFS Variability (1σ) = 0.76 Wm^{-2}

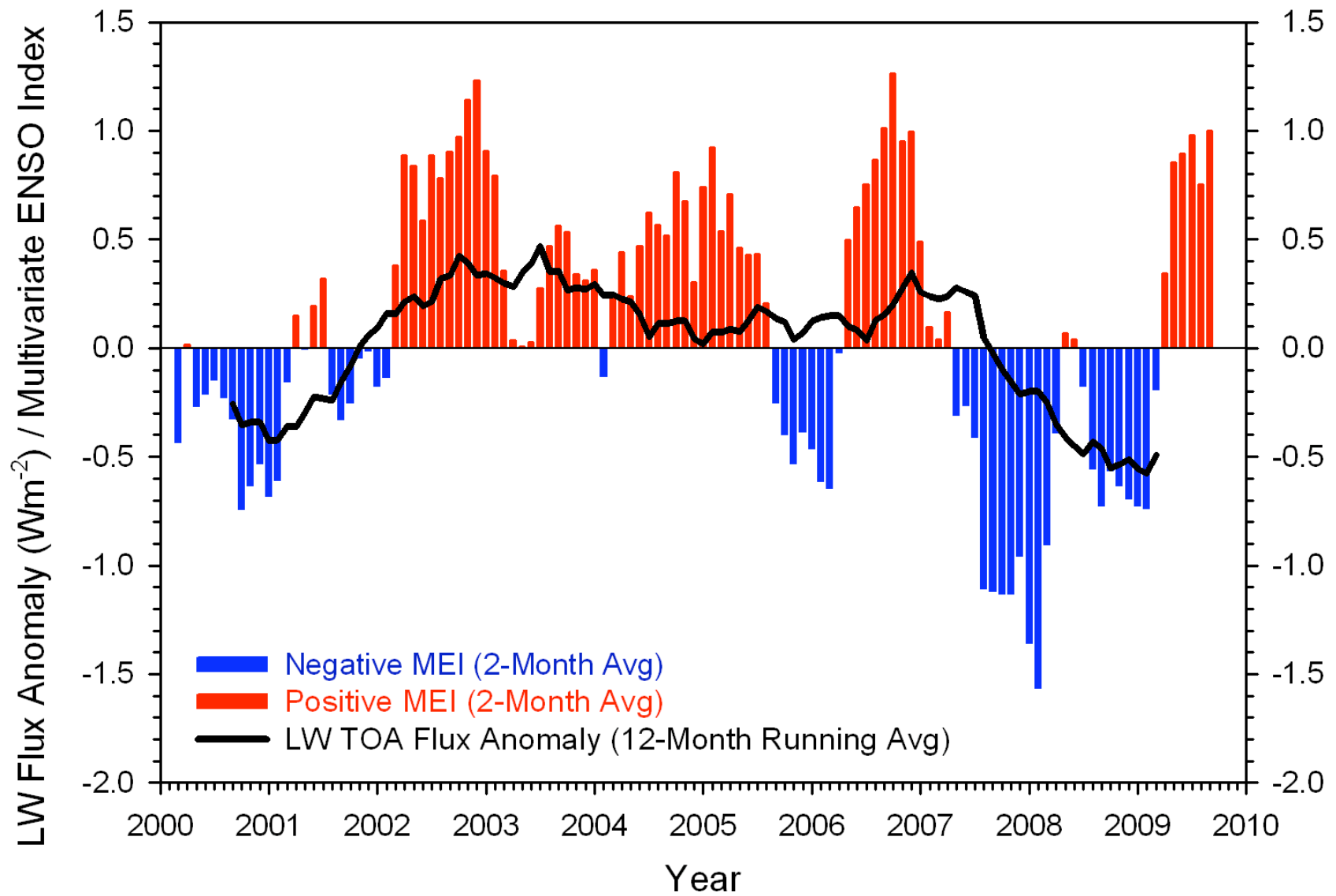
$\sigma(\text{CERES} - \text{SeaWiFS}) = 0.21 \text{ Wm}^{-2}$

✦ Shows consistent calibration stability at $< 0.3 \text{ Wm}^2$ per decade (95% conf)

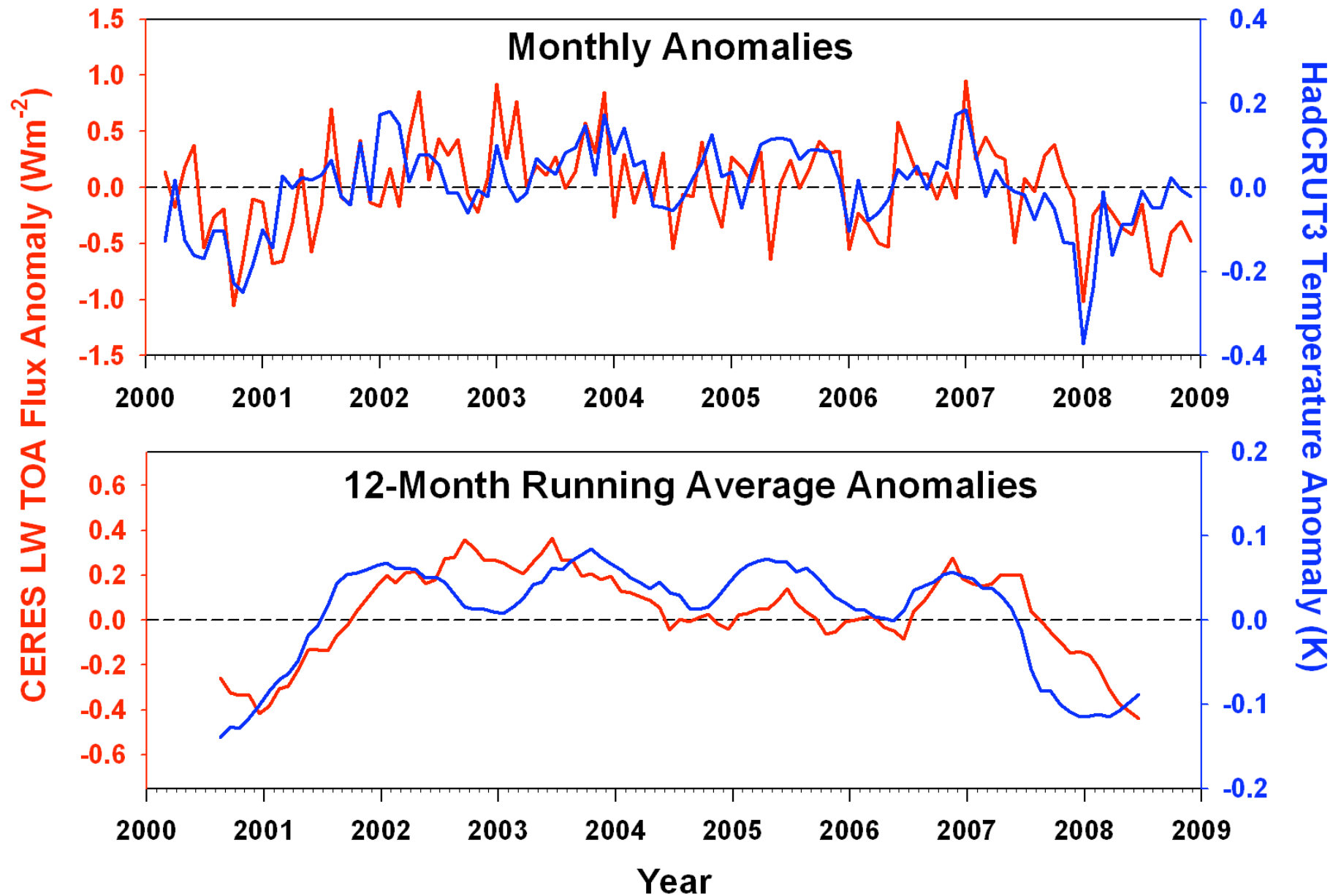
CERES SW TOA Flux and MODIS Cloud Fraction Anomalies (CERES_SSF1deg-Month_Terra_Ed2.5beta)



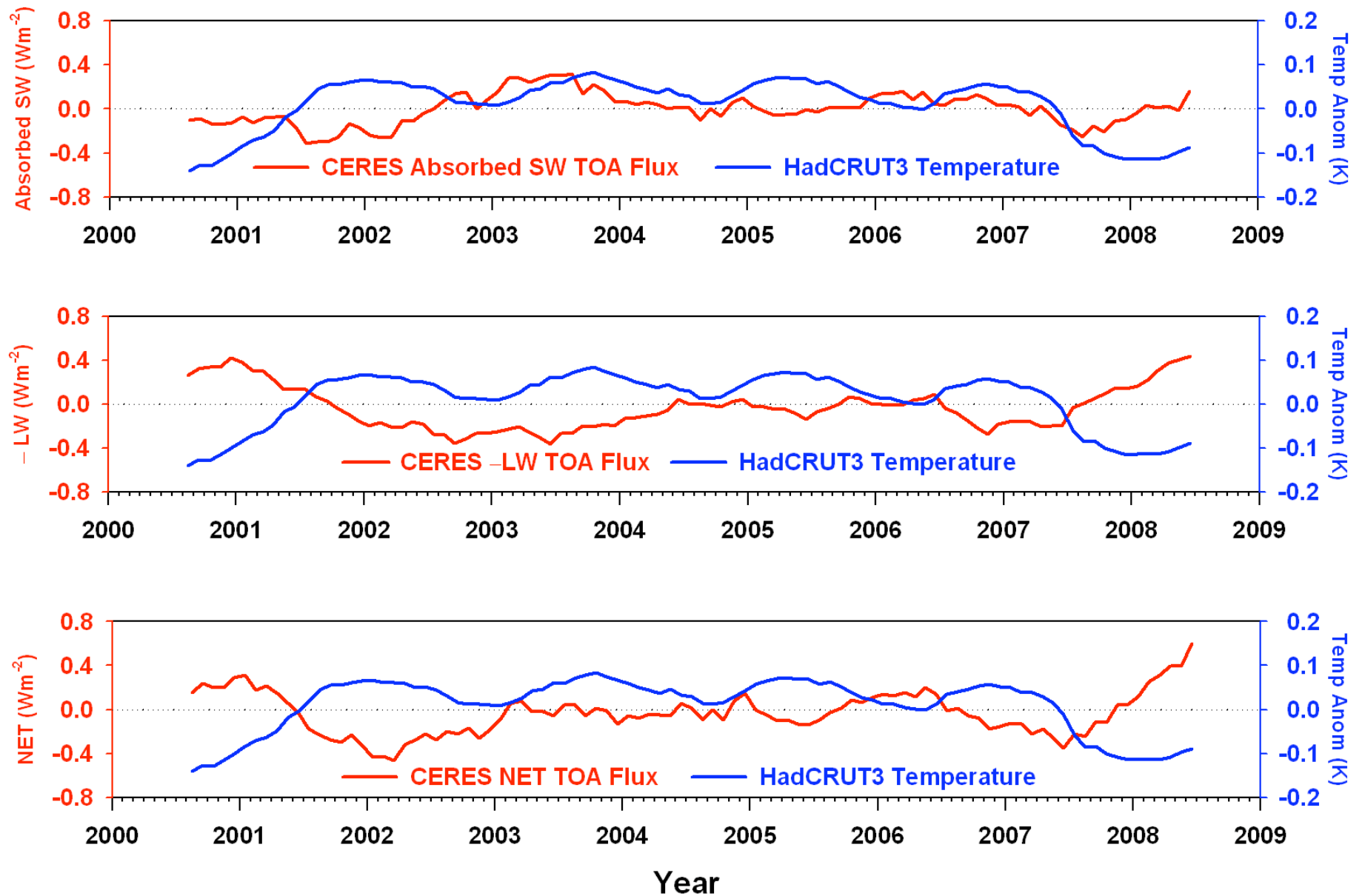
CERES Terra Global LW TOA Flux Anomaly vs Multivariate ENSO Index



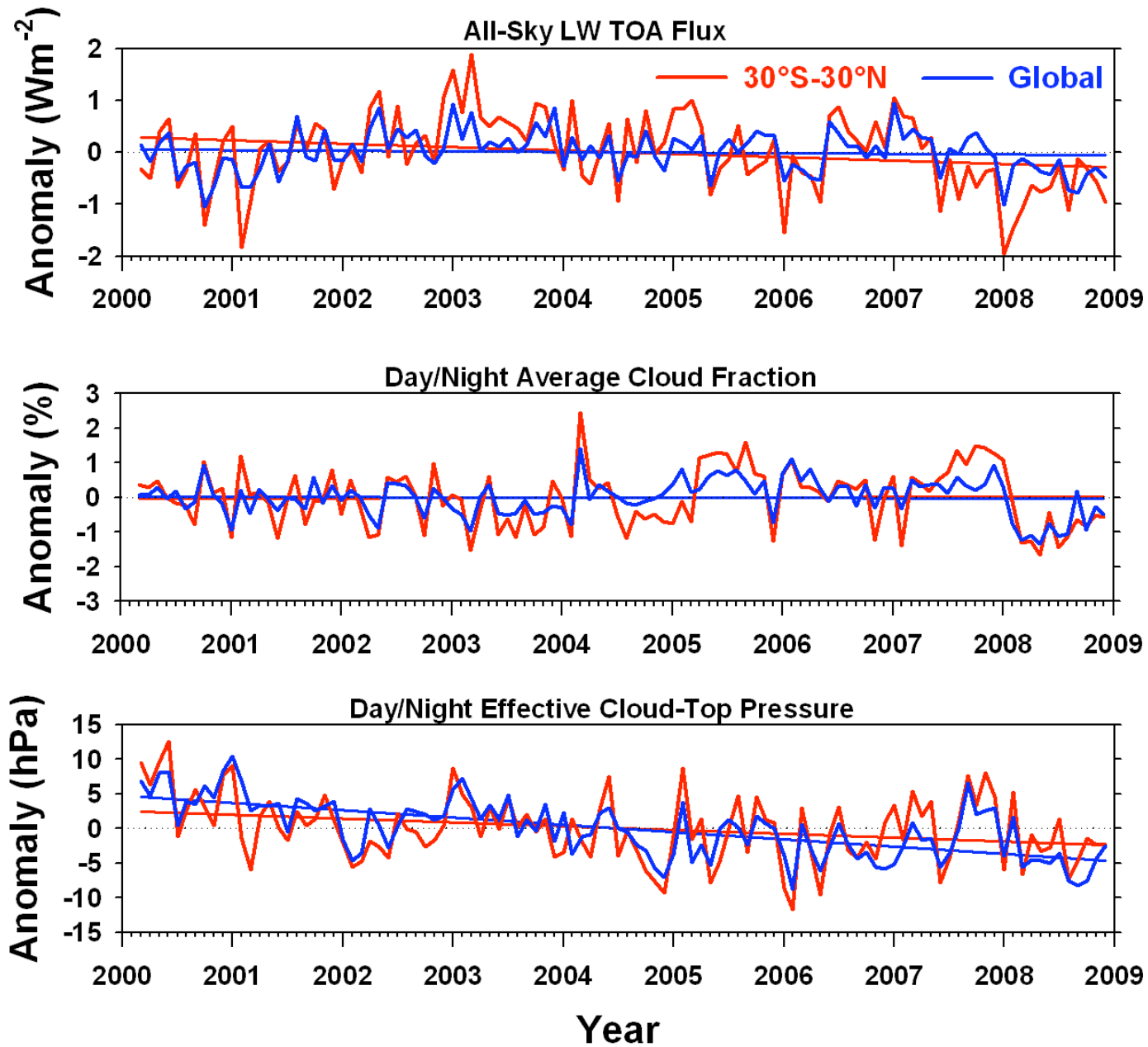
CERES All-Sky LW TOA Flux and HadCRUT3 Global Temperature Anomalies



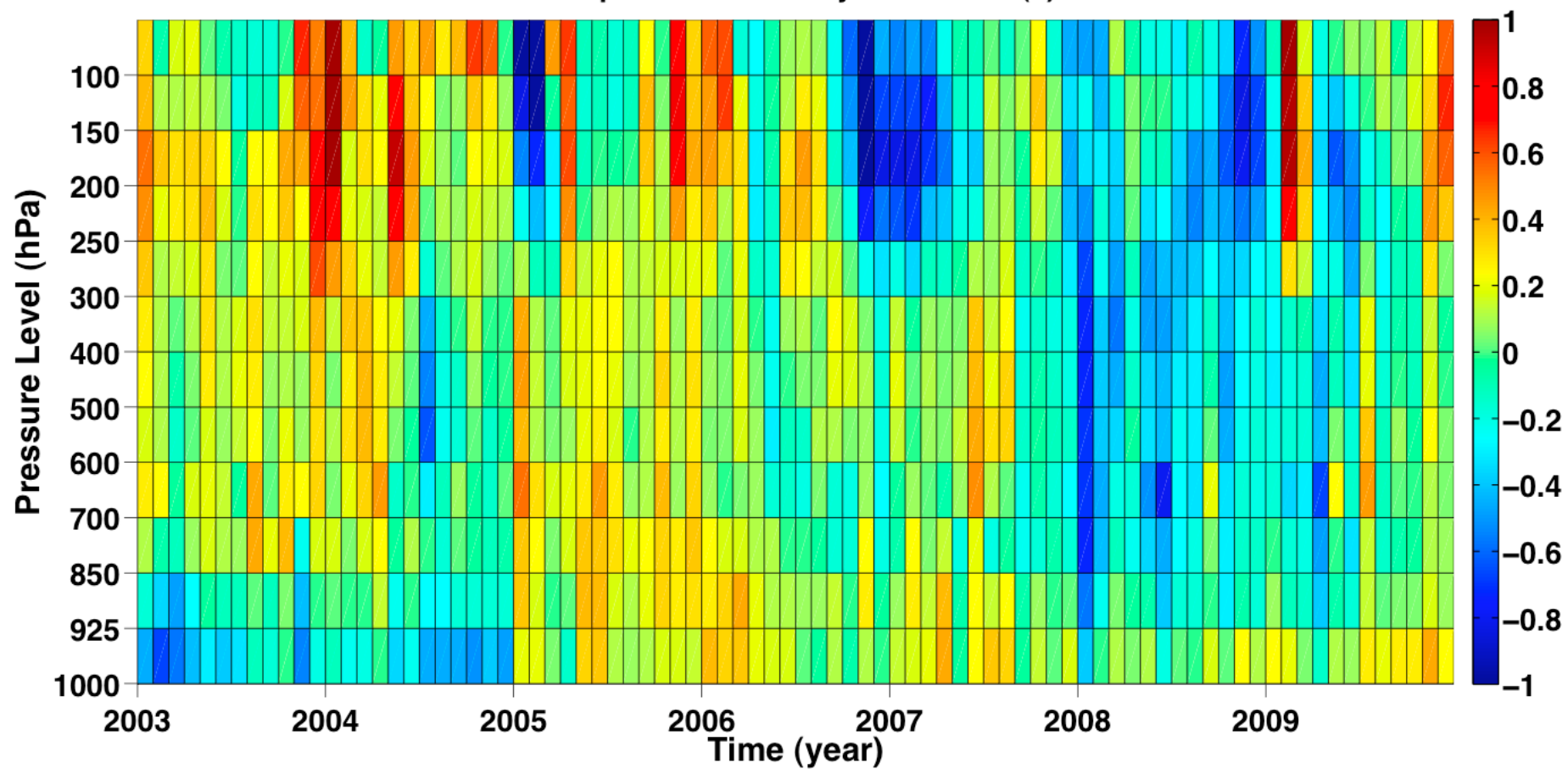
CERES All-Sky TOA Flux and HadCRUT3 Global Temperature Anomalies (12-Month Running Averages)



CERES LW TOA Flux and MODIS Cloud Property Anomalies



Temperature anomaly from AIRS (k)



CERES Perspective on Trenberth & Fasullo Science Perspective Article:

- CERES record shows remarkable consistency with other satellite observations (AIRS, SeaWIFS, MODIS) and closely tracks anomalies in global mean air temperature in response to ENSO variations, as expected.**
- Lack of closure of energy budget changes unlikely due to inadequate satellite measurement accuracy or inadequate data processing.**

CERES FM5 on NPP Update

- Official launch date: September 2011.
- Comprised of 5 instruments:
 - Visible/Infrared Imager/Radiometer Suite (VIIRS)
 - Cross-track Infrared Sounder (CrIS)
 - Clouds and the Earth's Radiant Energy System (CERES)
 - Ozone Mapping Profiler Suite (OMPS)
 - Advanced Technology Microwave Sounder (ATMS)
- Status:
 - CERES, ATMS, OMPS, VIIRS on NPP spacecraft.
 - CrIS: Thermal Vacuum (T/V) test was completed following re-build of electronics boards. Ship to NPP in June 2010 contingent upon result of test for flux contamination on selected power supply circuit card assemblies.
 - NASA is assessing science impacts of VIIRS sensor cross-talk and out-of-band responsivity. Results due first week of May.
 - Prelim. Finding: Optical crosstalk and OOB is a significant performance impact to Ocean Color & possibly aerosol product. NG is working a mitigation plan for on-orbit EDR algorithms.

CERES FM5 on NPP Update

- **Status:**
 - **NPP Ground System Interface Test (GSIT) March 15-26.** The test consisted of two Early Engineering Opportunities and a Run-For-Record 24 hours of continuous data flow. A total of approximately 33 Gigabytes of CERES FM-5 Raw Data Records (RDR) and VIIRS AOT and VIMD data from the Land PEATE were ingested and archived, and the test was declared a success for ERB CARS.

CERES FM6 on NPOESS C1

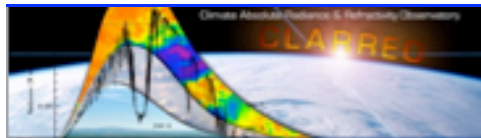
- CERES FM6 is a government-furnished sensor manufactured by Northrop Grumman (NG), and provided to the NPOESS JPSS program by NOAA/NASA.
- Northrop Grumman Aerospace System (NGAS) working under contract to NASA LaRC.
- Build-to-Print and from spare parts.
- Minor modifications needed to accommodate NPOESS C1 JPSS spacecraft interface and improve calibration. Accommodations change impact study is underway.
- Start Date: May 2009; Delivery Date: July 2012; Launch in 2014.
- Successfully complete dPDR January 20, 2010.
- NOAA/NASA discussions on CERES FM6 data processing ongoing.

A-Train Update

- **PARASOL** started drifting away from A-Train in early Jan 2009 due to insufficient fuel needed to maintain A-Train orbit.
- **Glory** launch expected November 22, 2010.
- **Japanese GCOM-W** may join A-Train in 2012 with successor to **AMSR-E** instrument.
- **CALIPSO** passed 1000 day-mark in orbit on January 23, 2009. Successfully transitioned to backup laser on March 9, 2009. Expect to release Version 3 data data products this spring from **ASDC**.
- New merged **CALIPSO-CloudSat-CERES-MODIS (C3M)** dataset: 1 year (Jul06-Jun07) has been processed. Plan to process seasonal months in 2008 next (see S. Kato Co-I presentation).

Decadal Survey

- **NASA still committed to implementing DS. Tier 1 Missions:**
 - **Climate Absolute Radiance and Refractivity Observatory (CLARREO)**
 - **Deformation, Ecosystem Structure and Dynamics of Ice (DESDynI)**
 - **Soil Moisture Active-Passive (SMAP)**
 - **Ice, Cloud, and Land Elevation Satellite (ICESat-II)**



CLARREO Mission Status

- Level 1 and 2 requirements are set – generated by science team based mission studies (model and observational) over the past 2 years
- CLARREO recent budget guidance calls for an initial launch target of 2017, second launch in 2020
 - We are reworking the baseline design to provide maximum science value within the new guidance
 - Instrument designs allow a wide range of launch and spacecraft options
- Partnering
 - Working closely with NIST on CLARREO metrology, SI traceability
 - CLARREO is working with the UK – agreement with NCEO, key contacts Nigel Fox (Solar Reflected), John Harries (IR)
- NASA ROSES Science Definition Team (SDT) announcement for proposals just released (March 2010). International proposals encouraged for collaboration
- Next Science Team Meeting in July
- MCR likely to be held in late summer / early fall



CLARREO ready to move into phase A